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Local Government, Information Systems, and Technology Transfer: Evaluating Some Common Assertions About Computer Application Transfer

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Everywhere we go nowadays faith is expressed that some modern technology is waiting in the wings to make our lives better. This extends to local governments where large programs have been instituted to facilitate "technology transfer"¹—a concept that usually refers to the process of moving a piece of technology developed at a high cost in one place to another place at a lower cost than would be required to develop the technology locally.²

The appeal of technology transfer is considerable and stems from several notions:

1. Technologies are interchangeable from one site to another, having "plug-in" features in the sense that they are relatively self-contained, prepackaged, readily learnable, and their implementation can be buffered against the impact of the larger environment.
2. High value is potentially redeemable from R & D investments which create or "spinoff" technologies that can be transferred extensively.
3. Users who are able to transfer can obtain high

■ The "faith in technology" attitude prevalent in the U.S. extends to local governments, where large programs have been instituted to facilitate technology transfer. This article examines the technology transfer of computer applications among and into city and county governments. It compares the benefit claims about application transfer, as expressed in seven key points most often found in literature about computerized information systems, with new data on local government transfer activity and the harsher realities of actual transfer experience. This article neither supports nor discredits claims about transfer of computer applications in local government. Rather, it attempts to fill part of the void in rational discussion about transfer by offering broad perspectives on why more transfers do not occur and, in some instances, why they shouldn't occur.

quality, sophisticated technologies without the need for making substantial development expenditures.

4. Certain technologies, such as management techniques, are instruments of political and admin-

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istrative reform, capable of "modernizing" public administration.³

Thus, the Federal Council on Science and Technology sees technology transfer as:

... critical to assuring that the results of an annual Federal investment of over \$15 billion in research and development are being applied to improve the services and quality of life of the Nation.

And, the importance given to technology transfer as:

... partly stimulated by the often quoted Presidential Message to Congress on Science and Technology in March 1972. Perhaps more important was the move toward "New Federalism" and revenue sharing, and the concern expressed by leaders at each level to actively spur the application of Federally sponsored research and development to state and local problems.⁴

Nowhere can the trend towards technology transfer be seen more clearly than in attempts to transfer computer applications between and among local governments. Computer application transfer in local government offers a classic case of technology transfer. General-purpose local governments appear similar in their functions and requirements. Computers are very alike in the functions they perform and are promoted for their interchangeability in handling different computer applications. Institutional support for application transfer exists in the form of policy support, financial aid, packaged programs, and technical assistance. Indeed, most of the current literature is highly enthusiastic about application transfer, highly optimistic about the ease and speed with which transfer can occur, and highly promotional about the dollar benefits to be derived.⁵

The image created about the transfer process is sometimes extreme.⁶ An urban technology transfer agent appears at city or county hall, carrying an arsenal of off-the-shelf, generalized, and pre-packaged computer programs ready to be plugged into the government's computer system. The technology agent has something for just about any operational or management problem ranging from utility billing to fire station location to collective bargaining negotiation. Without any difficulty, operating managers and data processing staff choose the application that fits their computer. Then the technology agent installs it, saving everyone the normal agony associated with developing computer applications in-house from scratch.

"Saving the day" is one of the images that makes application transfer appealing to local gov-

ernments. The touting of dollar savings makes software transfer irresistible. The following comments of a systems consultant typify the appeal:

As a concept, a design and an implemented system, GBIS [*Geographic Base Information System*] costs something on the order of a quarter of a million dollars. [Southern city A] will install this system for under \$40,000 plus a few man-months of data processing time.

[Southern city B] has saved something in excess of \$50,000 in choosing to accept PROVES [*Property Value Estimation System*] rather than designing their own system. Further, it is apparent that PROVES can be transferred to other cities at even more significant savings.

These facts speak for themselves: there is big money to be saved through the transfer of major systems. So for those of you who feel that yours may be better than mine, mine's cheaper than yours and it works, too!!

One would expect substantial software transfer to occur, based on these positive claims. Yet, the current level of applications transfer in the United States appears low in comparison to the amount of total development. In a survey we recently made of the transfer experience in cities over 50,000 and counties over 100,000 population in the United States,⁷ we found that only 22 per cent of the responding governments had transferred applications in the last two years.⁸ Twenty-three per cent of the responding cities and counties plan such transfers within the next two years (Table 1).⁹

Additionally, the average number of computer applications transferred per site over the past two years is not very great—1.4 applications in cities and 1.6 applications in counties (Table 2). The average number of applications planned for transfer over the next two years is similar, for both governments.¹⁰

Thus, in spite of the positive claims for transfer, relatively few local governments are transferring computer applications at all, and of those that are, few transfer more than one application. The major positive sign in the transfer patterns—one suggesting successful past experience—is that 60 per cent of the sites with transfer experience plan additional transfer during the next two years (Table 3).

Nevertheless, the low level of transfer casts doubt about the ease and benefit claims of application transfer. If the dollar savings are as great as transfer promoters say, why hasn't more transfer occurred? Why aren't more transfers planned? If transfer is so easy, why have most governments with transfer experience averaged only one application in the last two years? and, why are 40 per cent of the experienced governments planning no additional transfers during the

TABLE 1
SURVEY RESPONSE REGARDING TRANSFER
OF COMPUTER APPLICATIONS IN CITIES
AND COUNTIES

	Cities	Counties	Totals
Total number of local governments responding to URBIS survey	381	288	669
Per cent of governments responding to transfer experience portion of URBIS survey ^a	75%	59%	65%
Per cent of sites with transfer experience among responding local governments	18%	29%	22%
Per cent of governments responding to transfer plans portion of URBIS survey ^b	66%	52%	60%
Per cent of sites with transfer plans among responding local governments	22%	25%	23%

a. Number of respondents = 284 cities and 171 counties.
b. Number of respondents = 250 cities and 151 counties.

next two years (Table 3)?

The usual explanations for limited technological innovation offered in the literature focus on technical complexity, institutional constraints, and human frailties that create barriers to innovation.¹¹ These barriers undoubtedly operate with regard to transfer of computer applications as with other technologies. However, another explanation for the low level of application transfer may be more basic: *“who” really benefits from transfer of computer applications simply is more unclear than with other technologies, and given this uncertainty, few potential transfer participants are willing to risk engaging in transfer without outside stimulus* (e.g., a crisis, or external financial support).

Theoretically, application transfer should benefit all participants. Local government managers get modernization at a reduced price, within the constraints of their strapped budgets. Federal and state agencies, which assist local transfers or develop computer applications for transfer, get high leverage from a relatively low investment by demonstrating nationwide benefits from their R & D programs. The data processing professionals, who are providers of the technology, get status, recognition, and sometimes profit from their broker function. The department users in local governments get new tools for performing their jobs more efficiently and effectively. Ultimately, the taxpayer gets better service at a lower cost.

But, in reality, are the benefits of transfer

TABLE 2
FREQUENCY OF TRANSFER AND NUMBER OF APPLICATIONS TRANSFERRED
IN CITIES AND COUNTIES

	Cities	Counties	Totals
Have Transferred			
Governments with transfer experience	51	49	100
Total number of applications transferred	69	80	149
Average number of applications transferred	1.4	1.6	1.5
Plan To Transfer			
Governments that plan to transfer applications	54	37	91
Total number of applications planned for transfer	59	59	118
Average number of applications planned for transfer	1.1	1.6	1.3

TABLE 3
OVERLAP OF CITY AND COUNTY
GOVERNMENTS THAT HAVE TRANSFERRED
AND PLAN TO TRANSFER COMPUTER
APPLICATIONS^a

		Have Transferred		Total
		Yes	No	
Plan To Transfer	Yes	60	31	91
	No	40	305	345
	Total	100	336	436

^aThe chi square statistic is greater than the predicted chi square with a significance level of .001 having one degree of freedom. Thus, the data indicates that a site which has transferred in the past is more likely to transfer in the future.

always this clear cut? Actual experience with application transfer suggests that transfer is more complex than the "plug-in" process usually portrayed. More importantly, experience suggests application transfers do not always serve everyone's best interests. Some participants may gain important benefits, while giving up others. Some participants may gain very little in relation to the investment required of them.¹²

Claims and Realities

Differences between the benefit claims and the harsh realities of actually performing transfer can be seen by examining some popular assertions found in the literature on information systems in local government:¹³

1. Transfer of computer applications prevents each government from having to reinvent the wheel.
2. Everyone benefits from application transfer.
3. Computer applications can be transferred and adapted for a small fraction of the time and money needed to develop them in-house from scratch.
4. Transfer makes badly needed computer applications available at low costs to all local governments.
5. Application transfer is a short cut for local governments seeking an advanced state of EDP (electronic data processing) development.
6. Technical factors, such as the lack of standardized computer hardware and programming languages, are major barriers to application trans-

fer among local governments.

7. More application transfer would occur if there were a National Clearinghouse and Resource Center that would make information and computer applications available to local governments.

1. *Transfer of computer applications prevents each government from having to reinvent the wheel.*

An underlying assumption behind application transfer is that having each government develop its own applications is inefficient, if not wasteful. Therefore, application development projects should be done centrally and transferred to local governments in order to prevent costly duplication of effort. This prescription may be true, but it overlooks the important learning benefits derived from reinventing the wheel.

The process of developing computer applications offers individuals and the local government an exceptional opportunity to develop computing capability, within the constraints of local skill, time, and money availability. Computing staff professionals engaged in in-house development learn about various government functions. Department users learn about computing. And, both develop working relationships that support future operation, maintenance, and expanded use of computing. By contrast, application transfer may actually prevent learning. This is particularly true when transfer is performed by outside agents and the application exceeds local capabilities, as the computing staff and users are frequently under great time pressure and easily overwhelmed by the outside experts. In this situation, staff/user learning usually occurs later when the application is in operation and the staff has time to discover what the application really does and what assumptions underlie its models of reality. They, of course, also may discover that the application is ill-suited to local operations. Since computer applications, unlike a car, carry no warranty, there is no recourse with application "lemons."

Given that computing is still in its infancy in most local governments, learning opportunities that build in-house capability are especially valuable. Ironically, it is these governments with relatively undeveloped computing that are most often targeted for software transfer by the transfer agents on the deceptively rational grounds that transfer is most beneficial where local capability is weakest.

Contrary to this popular belief, the best candidates to undertake transfer may be the governments with highly developed EDP. Being sophisticated, these governments can better assess the potential of applications *before* they are implemented by outside experts. In addition, they are capable of undertaking the complexities of their own independent search, evaluation, and transfer.

Considerable evidence supports this view. The survey of U.S. cities and counties cited indicates that the greatest amount of transfer tends to occur in the larger governments and particularly in governments with an advanced state of EDP development. Table 4 shows that a greater proportion of larger cities and counties have transfer experience than smaller governments. Table 5 shows that the transfer governments tend to have higher EDP expenditures, spend proportionately more of their operating budget for EDP, have larger computer core capacity, have more applications operational, have more applications on-line, and have more applications documented than the average city or county in the survey, all of which indicates a relatively advanced state of development.

That the majority of these governments originally developed their own applications might be one important reason why they have become relatively sophisticated users of computing. In addition, transfer probably involves fewer risks for the larger more experienced governments because, unlike smaller inexperienced governments, they have sufficient skill to overcome adaptation problems and sufficient size to absorb unanticipated costs.

2. *Everyone benefits from application transfer.*

If application transfer yields all the beneficial things claimed for it, who could possibly resist transfer efforts? Depending on the situation, both the EDP and user departments might object.

Consider first the data processing professionals and users. In addition to the learning benefits, computing professionals and users stand to gain the personal and professional satisfaction that comes from their own design embellishments of the wheel. Since design is the *sine qua non* of the computer profession, the design-development phases of automating provide the most challenging

TABLE 4
PER CENT OF TOTAL URBIS CITIES AND COUNTIES TRANSFERRING COMPUTER APPLICATIONS, BY POPULATION*

Transfer Experience	Cities		Counties	
	URBIS Respondents (A)	Have Transferred in Last Two Years (% of A)	URBIS Respondents (B)	Have Transferred in Last Two Years (% of B)
Totals	284	18%	171	29%
Population Groups				
500,000 and over	19	42	38	34
250,000-499,999	27	22	46	28
100,000-249,999	74	15	87	26
50,000- 99,999	164	16	—	—
Transfer Plans	Cities		Counties	
	URBIS Respondents (A)	Plan To Transfer in Next Two Years (% of A)	URBIS Respondents (B)	Plan To Transfer in Next Two Years (% of B)
Totals	250	22	151	25
Population Groups				
500,000 and over	15	27	32	25
250,000-499,999	23	30	41	22
100,000-249,999	66	23	78	26
50,000- 99,999	146	19	—	—

*119 cities and 139 counties failed to answer this question

TABLE 5
COMPARATIVE STATE OF EDP DEVELOPMENT AMONG CITIES AND COUNTIES
THAT HAVE TRANSFERRED-IN APPLICATIONS

Indicators of EDP Development Status	Cities		Counties	
	Transfer Sites	All URBIS Cities	Transfer Sites ^a	All URBIS Counties
Average EDP expenditures	\$891,031	\$554,444	\$1,345,933	\$965,155
Average EDP expenditures as a percent of total operating budget	1.4%	1.0%	1.8%	1.7%
Average total core capacity in bytes	596K	346K	598K	450K
Average total operational applications	44	31	39	32
Average total operational applications on-line	11	6	7	6
Average total operational applications with documentation	25	15	24	18

^aThis includes only places that have transferred-in. As might be expected, places that have transferred-out have somewhat higher values.

and creatively fulfilling jobs for many programmers and analysts. By contrast, the transfer adoption process is generally viewed as unstimulating, even drudgery.¹⁴

"Professional practice" is to department users what design is to the computer staff. User department people develop small differences in local practice as a means of maintaining and building recognition and professional superiority over their counterparts in other governments. Users frequently assert that "we are different from City A," "our department does not function like County B," "our procedures are better than theirs." Thus, many user departments are preconditioned to reject a system developed for another local government with a "different" situation. Their position frequently is reinforced by the patchwork of state and local statutes governing local governments' operations and the already differing pattern of standard operating procedures.¹⁵

Data processing professionals and users are not the only ones who might resist transfer. Bureaucratic incentive and resource politics enter into considerations about transfer, particularly for the managers in the EDP and user departments. When development is done in-house, or when transfer is done by in-house staff, the monies essentially go to increase staff in the EDP department, the user

department, or both. When software is transferred in by an outside agent, a large portion of the money that could otherwise be used for development goes outside to the transfer agent. While the local staff is strained with the transfer burden, it generally receives no additional budgetary support. The net effect is that the EDP and the user department managers lose a substantial basis for future budgetary increases and must use the "slack resources" under their control to assist in the transfer effort.

These erosions of operating funds might be all right with the managers if they were rewarded for efficient resource use. But generally they aren't. There is no more professional prestige for managers than the staff from transfer-in; and, there aren't additional resources either. In fact, the budgeting-from-past-history practices of local government means that managers generally will be rewarded with increased budgets only for accumulating staff in-house rather than for using outside resources, and for using their current staff inefficiently rather than efficiently.¹⁶

Thus, both managers and staff in the EDP and user departments, accustomed to traditional bureaucratic incentives and practices, are preconditioned to find shortcomings with the transfer process and have built-in technical and professional arguments to support local development

rather than transfer. The combination of such technological and professional arguments usually has a significant impact on other decision makers, such as chief executives who might otherwise strongly favor transfer from another government.¹⁷

3. *Computer applications can be transferred and adapted for a small fraction of the time and money needed to develop them in-house from scratch.*

This benefit holds the strongest attraction for software transfer and provides the dominant basis for promotional claims. Undoubtedly, substantial cost savings can occur from transfer because most of the front-end development costs have been borne by others. The transferee bears only the costs required to adopt the application locally. In reality, however, such savings only occur under the best of conditions: when the automated task is truly general, when the application has been well documented and designed for transfer, when the computer programs fit the transferee's current computing capability, and when the application is relatively self-contained. Unfortunately, it is common for any or all of the following technical problems to occur:

The automated task is poorly suited to the local situation. Some computer applications have low transfer potential across state or regional lines because of differences in state and local information requirements and operating procedures. This is particularly true with regard to sophisticated applications such as real property appraisal models and complex operational applications such as integrated utility billing and on-line customer inquiry. Simpler models, such as Fire Station Locator, and report generators, such as Uniform Fire Incident Reporting System (UFIRS), are easier to transfer.¹⁸

The application is poorly documented. Poor programming documentation can be worse than no documentation because it can mislead transferees about the net benefits of transferring the application and may lead them far along the wrong paths in converting and debugging the programs for the local situation.

The application is poorly designed. One city that transferred-in an accounting package discovered that the programming audit trails were woefully inadequate. The city had to redevelop the program at considerable expense, in addition to bearing the cost of the initial transfer failure.

The application is not designed for transfer. Some otherwise well-designed applications simply have not been designed with their potential transfer in mind. Therefore, the cost of their modification for transfer exceeds the potential development savings.

The application is part of an integrated system, and thus contains features not required for stand-alone use, or delivers its benefits only in an integrated EDP environment. The first of these conditions is pointed out by an observer of the Charlotte USAC Project:

Remember that in taking an IMIS [Integrated Municipal Information System] product you are taking a part of a system, but the system doesn't exist [in your situation]. So there may well be programming niceties, data handling, and so forth that are unnecessary and turn out to be costs rather than benefits.¹⁹

The second situation occurs in applications such as Detective Investigative Support where the real benefits of the application come from integrating the data in many normally separate police operational files. Here the transferee can obtain the applications benefits only by building an integrated system, at least for those aspects of the police function that provide the operational data.

4. *Transfer makes badly needed computer applications available at a low cost to all local governments.*

Even if there are no problems in transfer and development savings do occur, the savings are meaningful only if the transfer-in application meets a real need in the government and is economical to implement, operate, and maintain. Thus, application transfer should be viewed in terms of priority needs rather than simple availability, and in terms of full life cycle costs, rather than the mere saving of development costs.

Assessing the need for transfer-in applications is a universal problem. Thinking that they are "getting something for nothing," many local officials are lured into application transfer when in fact they may be getting something they don't need, or which meets local needs only marginally. This problem occurs because some applications promoted for transfer to local governments are designed primarily to serve non-local needs, such as state and federal needs for criminal data and national statistics, and thus have only secondary local value, if any, to the local government. Transfer in local government sometimes is induced by promotional literature extolling the benefits of

the applications, and by offers of technical assistance and financial support for the transfer-adaptation phase. Once implemented, local officials may discover that the application doesn't live up to the benefits claimed for it, yet it requires a continuing financial commitment for maintenance as part of the federal-local agreement.²⁰ This general situation has led one observer to quip that USAC's Integrated Municipal Information System (IMIS) project is "another example warning the cities to beware of Greeks [in this case, the feds] bearing gifts."²¹

Another consideration for application transfer is its net benefit over its full life cycle.²² Development savings from transfer may pale in the face of costs for operation and maintenance. Some applications simply are expensive to operate because they were not designed with operation and maintenance costs in mind. Others are expensive because the originators issue frequent changes or enhancements that have to be implemented. Other applications are expensive because they require new data collection and updating procedures not previously performed by the local government. This is particularly true of federal-agency proffered applications that establish a new reporting system or get the local government to accept responsibility for an activity not previously performed locally.²³

Thus, local officials who make the transfer decision on the basis of development savings alone may discover that unforeseen costs exceed these savings when they encounter technical problems, low benefits, or life cycle costs connected with the automated task.

5. Application transfer is a short cut for local governments seeking an advanced state of EDP development.

This notion of "a quick technological fix is sometimes used to promote application transfer and, although appealing, it simply doesn't square with reality. As mentioned already, transfer is not occurring at a rapid pace, and most governments with transfer experience transferred only one application in the past two years (Table 2).

These findings should not be surprising for several reasons. First, the search for transferable applications requires extensive professional contacts, at least within the same state, because the small number of applications available and acceptable are difficult to find even with the aid of various computer software catalogs.²⁴ A rich

network of professional relationships is likely to be developed only in larger, experienced installations that have overcome pressures to show immediate payoffs and adapt to vendor equipment changes.

Second, the assessment of somebody else's software is complex and requires that the transferee government have personnel with experience and sophistication comparable to the source's EDP staff and user department personnel.

Even if the application bears the "Good House-keeping Seal of Approval" from a national public interest group, the transferee still requires adequate staff skill locally for implementation. Should the application be installed by an urban technology transfer specialist, the transferee still will need a local staff skillful enough to maintain the application after the transfer-adaptation phase ends.

Thus, successful application transfer requires technical sophistication by the host government that is similar to that needed to develop the application. It is not a quick, easy way to get such sophistication.

6. Technical factors, such as the lack of standardized computer hardware and programming languages, are the major barriers to application transfer among local governments.

The considerable variety in computer mainframes, operating systems, and peripheral devices used among local governments creates compatibility problems in adapting applications from one computing environment to another.²⁵ Most of these compatibility problems now have known solutions and do not present the same transfer barriers as in times past.²⁶ In addition, diversity of programming languages represents a lessened barrier to transfer today, since most local governments have adopted COBOL as their common programming language for administrative applications and FORTRAN for scientific-engineering applications.

While transfer barriers due to hardware and languages are lessening, "design for transfer" looms large as a barrier primarily because of institutional and behavioral factors. Local agencies tend to design computer applications only to fit local conditions rather than to be generalized because frequently there are no special incentives to design for transfer. Generalized approaches take more time and money to develop, involve commitment to greater hardware and software expendi-

tures for operation, and inevitably result in compromises for local users. Without special incentives, therefore, local agencies are unwise to bear these costs. However, sometimes this position is taken even by system designers working on federally supported projects where special monetary incentives are provided to develop generalized applications for use by other governments.²⁷ This human tendency to design suboptimally for local conditions may result from lack of knowledge about how to design for transfer, or from lack of personal/professional incentives, or both.

A related tendency of some computer professionals is to design for "leading edge" technology rather than within the mainstream of existing technology. "Leading edge" design offers many incentives for the designer. It actually enhances the designer's job because the more advanced technology automatically provides many functions the programmer previously had to design as part of each application, and it permits sophisticated niceties to be built into the application.²⁸ The designers sometimes are aided by enthusiastic users who can think up frills that the designers may have overlooked.²⁹ These features, which make the application unique and bring professional distinction to EDP staff and department users alike, can also render the application difficult to transfer to less advanced EDP installations.

Thus, the lack of institutional incentives for local agencies to design for transfer and the behavioral tendencies to design suboptimally for local conditions and for leading edge technology—frailties which affect the EDP and user staffs alike—probably constitute greater current barriers to transfer than the lack of technical standardization.

7. More application transfer would occur if there were a National Clearinghouse and Resource Center that would make information and computer applications available to local government.

Some proponents of application transfer correctly argue that the greatest benefits of transfer will occur when a particular computer application is installed nationwide among many local governments. To effect this, they would establish a National Clearinghouse and Resource Center for application software. The clearinghouse would keep current information on each local government's computing system, application availability, and future needs and thereby "broker" exchanges of applications among local governments with

comparable application-technology mixes. Among other things, the resource center would collect and maintain well-designed and documented "application packages" that it would transfer or make available to interested governments under membership or contract arrangements.³⁰

Although the idea for some kind of national center might be a good one, and indeed is supported by local government officials,³¹ there are several problems with the above conceptions. A clearinghouse capable of storing and updating information on each government's applications and host computing system would be costly to build. Updating the information might be a problem since frequent changes in local computing technology could require keeping information on each "version" of an application. Therefore, the costs of maintaining the clearinghouse information could swamp the start-up costs.

Moreover, local motivation to contribute information about applications to the clearinghouse could lessen as each government's costs become clear. Periodically, each participating government would need to update its information profile in the clearinghouse and each would need to bear the cost of documenting its applications, something few governments now do. Those governments with a "popular" application would need to control the "versions" of the application every time it underwent technology changes or design enhancements. And each government would have to bear the cost associated with handling inquiries and visits from other governments exploring the possibility of transfer.

Assuming exchanges result, governments with few applications to offer but much to gain from exchanges would have the greatest incentive for participation, while governments with extensive applications might be deluged with requests for information and assistance with little to gain in exchange. When the costs became too great, these governments might withdraw from the clearinghouse causing an end to the operational feasibility so dependent on the participation of the more advanced (but not necessarily the most sophisticated) governments.

Participation might be maintained and the clearinghouse might have value commensurate with its costs if focused on facilitating the search phase of application exchanges, thereby limiting the scope of data collection, maintenance, and exchange. Most initial searches involve looking for a particular application of interest available on a

comparable computing system. Once preliminary information indicates a fit, there is need for follow-up search and inquiry that requires more detailed information than need be kept in a central information bank, along with direct personal communication with potential application sources. Thus, the feasibility and value of a clearinghouse to information transfer about computer applications appears reasonable if its operation is limited to facilitating the initial search for applications, and local follow-up.

While a limited clearinghouse function is potentially useful to information transfer, the resource center would be of low utility to physical transfer of computer applications. The assumption underlying the resource center—that most applications can be transferred nationwide from a single center—is problematic given the current pattern of transfers. Table 6 shows that the dominant pattern of current application transfer involves transfers from one local government to another (“local to local”) rather than transfers from “centers” such as federal or state agencies, or urban technology transfer agencies. Table 6 also shows that, overall, more transfers occur within the SMSA or state (47 per cent) rather than cross-country (37 per cent).

However, the pattern varies considerably between cities and counties. Forty-eight per cent of the cities transferred applications from “outside the state” and 28 per cent transferred from “inside the state” or “inside the SMSA.” This difference between cities and counties may be related to the pattern of federal funding support for transfer which has favored cities until recently.

There are several practical reasons for the overall pattern of “local” transfers despite these differences between cities and counties. One reason is that state-to-state differences in administrative procedures reduce the likelihood that suitable applications, particularly operations-oriented applications, will be found in another state if they can’t be found locally. Another reason for the dominance of intra-state transfer is that local governments restrict out-of-state travel more than local travel. Also, the need for communication (user-to-user and analyst-to-analyst) throughout the transfer-adoption process is extensive and is greatly facilitated by geographic proximity which reduces travel time and costs. Lastly, computer professionals rely heavily upon personal knowledge of the skill and programming practices of other computing installations in making software transfer decisions, and this knowledge is gained by frequent, extensive peer contacts which also tend to be circumscribed by state or regional boundaries.

It is also significant to note that the primary kind of application packages currently available from federal agencies and other urban technology transfer agencies tend to be stand-alone, management-oriented applications such as reporting systems, resource allocation models, and facility location models. These are relatively easy to “standardize” and to transport from one place to another. Yet, these kinds of applications have relatively low priority locally as shown in Tables 7 and 8.

Most local governments place first priority on

TABLE 6
SOURCE AND LOCUS OF TRANSFERRED APPLICATIONS

Transferred From:	Cities		Counties		Totals	
Source of Application						
Local to local ^a	78%	(54)	95%	(76)	87%	(130)
Federal state to local ^b	22	(15)	5	(4)	13	(19)
Totals	100	(69)	100	(80)	100	(149)
Locus of Transfer						
Inside SMSA ^c	14%	(10)	16%	(13)	15%	(23)
Inside state	14	(10)	48	(38)	32	(48)
Outside state	48	(33)	16	(13)	31	(46)
Unknown ^d	24	(16)	20	(16)	22	(32)
Totals	100	(69)	100	(80)	100	(149)

a. From either a city or county to another city or county.
b. From a federal or state agency or an urban technology transfer agency.
c. Standard Metropolitan Statistical Area.
d. Source of transferred application not indicated in response.

TABLE 7
KIND OF APPLICATIONS TRANSFERRED

Kind of Application	Cities	Counties	Total
Management-oriented	25	18	43
Operations-oriented	44	62	106
Total	69	80	149

automating the "bread and butter," operations-oriented tasks of government (Table 8). Increasingly they also place priority on making these

applications "on-line" and "integrated" (data not shown). However, even simply operations-oriented applications tend to have low transferability because of differences in local administrative procedures. When these applications are additionally on-line and integrated, it is nearly impossible to transfer them without replicating the original EDP system and application in the new host environment.³² While transfer makes these systems cheaper, they are still very expensive and complex; thus, there are likely to be few of such transfers.

The nonstandardness, complexity, and cost of

TABLE 8
APPLICATIONS TRANSFERRED BY GOVERNMENT FUNCTION

Function	Number of Applications Transferred			Function	Number of Applications Transferred		
	Cities	Counties	Total		Cities	Counties	Total
Police/Sheriff				Budget preparation/accounting	2	4	6
Law enforcement statistics/crime reporting ^a	3	1	4	Purchasing	1	2	3
Law enforcement "package"	3	—	3	Personnel	3	—	3
Other law enforcement	5	3	8	Geoprocessing	5	1	6
Fire				Data Processing	2	1	3
Fire incident reporting	4	—	4	Public Information	—	—	—
Fire station locator	3	—	3	Clerk/Recorder	1	2	3
Courts				Public Buildings	1	—	1
Jury selection	—	7	7	Central Garage/Equipment Management	3	2	5
Other court applications	3	9	12	Planning and Zoning	—	1	1
Emergency Preparedness	—	—	—	Housing and Urban Renewal	1	—	1
Accounting				Transportation	4	1	5
General accounting/financial management	5	6	11	Utilities			
Payroll preparation and accounting	5	7	12	Water/electric billing	—	3	3
Treasury/Collection/Assessment				Public Health	1	3	4
Personal property records	—	2	2	Public Welfare			
Real property tax records/billing	—	4	4	Assistance records/food stamps/disabled/general	2	6	8
Other tax records	5	3	8	Information and referral	1	2	3
Budgeting and Management				Other	—	1	1
Budget monitoring	—	2	2	Libraries			
				Catalogue/circulation	3	—	3
				Vital Statistics	—	—	—
				Voter Registration			
				Registration records	1	2	3
				Vote counting	—	3	3
				Miscellaneous	2	2	4
				Totals	69	80	149

many operations-oriented applications means that they probably cannot be handled as a "product" by the resource center. Therefore, the applications with greatest local demand and priority probably would not be handled by the resource center. Rather, the center would be limited to handling applications that many local officials might regard as "management frills" and might therefore ignore until they have completed more basic automation locally. Thus, the value of the resource center may be questionable.

One area in which the resource center could be of great value is the professional evaluation of application software, particularly standard packages promoted by federal agencies or private vendors. But, because it is too controversial, the center is unlikely to perform this function. In order to obtain continuing financial support from various federal agencies, the center could become a promoter for government-produced applications. Consequently, it could exacerbate, rather than help solve the evaluation problem for local governments.

Summary and Conclusion

Application transfer is a logical idea and has substantial benefit, providing everything works right. But, the experiences of cities and counties show that frequently something goes wrong. Therefore, local officials who must decide whether to transfer a computer application from outside or to develop it in-house must soberly assess the complexity of the transfer-adaptation process and the technical and behavioral factors that constrain it. Much of the literature on transfer will not be of much help to them because of its strong promotional bias. Some of the government and private agencies aren't very helpful either, since these agencies have a potential conflict between their interest to promote their own or others' application software to local communities and their purported interest in assisting local governments.

This article has tried to fill part of the void in rational discussion about application transfer by critical examination of some popular beliefs. Not surprisingly, the assessment brings neither acclamation nor disproof of the basic merits of application transfers. Rather, it has offered broad perspectives on why more transfers don't, and in some instances shouldn't occur. One perspective focused on the necessary conditions for any real cost savings to occur from transfer. Another focused on real and imagined technical barriers to application transfer.

Still another perspective pointed to behavioral factors in transfer, which are the heart of technical and cost problems, but which are important barriers to effective transfer in their own right.

The issues raised here about application transfer may be applicable to urban technology transfer generally. They point to the need for more critical examination of basic tenets in the field. They also point to the need for systematic research into the transfer process and into the relative costs and benefits of transfer for different local government activities and functions. Lastly, they suggest that further critical examination of proposals for a National Clearinghouse and Resource Center for information technology may be warranted.

Notes

1. An excellent overview of the major programs is contained in Robert Crawford, "The Application of Science and Technology in Local Governments in the United States," *Studies in Comparative Local Government*, Vol. 7, No. 2 (1973), pp. 1-19; and Federal Council on Science and Technology, *Directory of Federal Technology Transfer* (Washington, D.C.: U.S. Government Printing Office, 1975).
2. The idea of transfer is expressed differently by different organizations. Defense and space programs describe technology transfer as the process of employing a technology for purposes other than that for which it was developed. For example, see National Aeronautics and Space Administration, *Spinoff 1976: A Bicentennial Report* (Washington, D.C.: NASA, Technology Utilization Office, 1976), p. 3. The Federal Council for Science and Technology defines technology transfer more broadly as "the process by which existing research knowledge is transferred operationally into useful processes, products, or programs that fulfill actual or potential public or private needs." Federal Council for Science and Technology, p.v.
3. In the latter sense, technology transfer has been part of the experience of American public administration at least since the '50s. See William J. Siffin, "Two Decades of Public Administration in Developing Countries," *Public Administration Review*, Vol. 36, No. 1 (January/February 1976), pp. 61-71; and "Policy Management Assistance — A Developing Dialogue," *Public Administration Review*, Vol. 35, Special Issue (December 1975).
4. Federal Council for Science and Technology.
5. For example, see: The Urban Institute, *The Struggle to Bring Technology to Cities* (Washington, D.C.: The Urban Institute, 1971); "Managing Data for Decisions," *Public Management*, Vol. 53, No. 10 (October 1971); "Innovations in Local Government," *Public Management*, Vol. 57, No. 4 (April 1975); Robert Wilson, "An Planned Program," *Urban and Regional Information Systems: Information Research for an Urban Society*, Vol. II, Papers from the Tenth Annual Conference of URISA (Urban and Regional

- Information Systems Association) (Claremont, Calif.: URISA, 1973), pp. 95-98; James R. Paul and John L. McCarty, "FAMIS - A Study of System Transferability," *ibid.*, pp. 99-115; and Joseph E. Staszak, "Financial Management Systems: Transfer for Results," *Urban and Regional Information Systems: Perspectives on Information Systems*, Vol. II, Papers from the Twelfth Annual Conference of URISA (Claremont, Calif.: URISA, 1974), pp. 21-26.
6. This has always been a problem with the images conveyed by equipment vendors and software firms who market computer applications, and has led to their claims being treated skeptically by knowledgeable buyers. Some of the more surprising offenders in recent years are federal agencies and federally sponsored urban technology transfers groups. Since their claims might be taken more seriously, this development bears watching.
 7. The survey is part of a research project called URBIS, for *Urban Information Systems*. The project objective is to evaluate information technology in local government. Two questionnaires - one dealing with the computing installation's environment and another with computing applications - were sent to the data processing managers, and one questionnaire was sent to chief executives dealing with their perceptions of computing. An overview of the project is provided in Kenneth L. Kraemer and John Leslie King, "The URBIS Project: A Policy-Oriented Study of Computing in Local Government," *Computers, Local Government and Productivity*, Vol. I, Papers from the Thirteenth Annual Conference of URISA (Chicago, Ill.: URISA, 1976), pp. 406-429.
 8. The questions asked about *transfers from another local government* (i.e., city, county, school district, special district, or regional agency). The survey did not specifically request information about transfers from federal or state agencies, computer manufacturers, software vendors, or organizations which specialize in urban technology transfer (e.g., Public Technology, Inc.). These data were collected indirectly through a checklist of computer applications which included major "transfer packages," particularly those available from federal agencies. In addition, some of the respondents listed computer applications from these non-local-government sources in their replies about transfers from other local governments. These non-local sources are included in the data presented here and treated separately wherever possible. However, since the survey did not specifically ask about these non-local-government sources, the data about these sources should be considered only suggestive.
 9. By contrast, we estimate that 65 per cent of the responding cities developed one or more applications in-house during the last two years and 67 per cent of the responding counties developed applications in-house. These percentages are conservative estimates. In addition, 87 per cent of the cities and 83 per cent of the counties plan to develop applications in-house or to transfer-in applications over the next two years.
 10. By contrast, we estimate that the average number of computer applications developed in-house per site over the past two years is 6.3 in cities and 5.4 in counties. These averages are conservative estimates. In addition, the average number of applications planned for development and transfer over the next two years is 28.6 in cities and 24.2 in counties.
 11. The literature on innovation is vast, but the following studies specifically focus on "barriers" to innovation: Arthur D. Little, Inc., and Industrial Research Institute, Inc., *Barriers to Innovation in Industry: Opportunities for Public Policy Changes* (Washington, D.C., 1973); Organization for Economic Cooperation and Development, *The Conditions for Success in Technological Innovation* (Paris: OECD, 1971); *Project SAPHO, A Study of Success and Failure in Innovation* (Brighton, England: Science Policy Research Unit, University of Sussex, 1971).
 12. Anthony Downs was the first to suggest that computerized information systems would have political impacts in addition to technical ones in "A Realistic Look at the Final Payoffs from Urban Data Systems," *Public Administration Review*, Vol. 27, No. 3 (1967), pp. 204-210. Downs focused on political impacts from the "information" contained in automated systems rather than from the systems themselves. For discussion of this distinction and political impacts from automated systems per se, see: Kenneth L. Kraemer and John Leslie King, *Computers, Power and Urban Management: What Every Local Executive Should Know* (Beverly Hills, Calif.: Sage Publications, 1976); and Rob Kling, "Automated Information Systems in Public Policymaking," Working Paper No. 76-16 (Irvine, Calif.: University of California, Public Policy Research Organization, 1976).
 13. This evaluation, though conducted without an evaluation research design, is nevertheless systematic and empirically based, using data from the URBIS survey, reported experiences from the USAC projects, exploratory case investigations in several local governments, and case descriptions in published literature. The URBIS survey is described in Note 7 above. The USAC (Urban Information Systems Inter-Agency Committee) projects were sponsored by a consortium of ten federal agencies, conducted in six municipalities, and involved research and development of information systems for municipal governments with transferability as a major objective. Sources of information on the USAC experiences include the publications of individuals associated with the projects, official project reports, and the author's personal involvement and visits to the project sites over a period of five years. Some observations from the case work are reported in James N. Danziger, "Computing, Local Governments, and the Litany to EDP," *Public Administration Review*, Vol. 37, No. 1 (January/February 1977).
 14. Danziger, p. 28. For example, talks at the annual conferences of the Urban and Regional Information Systems Association (URISA) tend to focus on new applications, new approaches or plans for transfer rather than on "successful transfer experiences." One reason may be that the realities of transfer involve difficulties and uncertainties that few people are eager to talk about. The difficulty and uncertainty surrounding transfer is cautiously conveyed in the

following "abstract" from a URISA conference paper by a participant in the City of Fresno's experience with transfer of a complex financial information system from the City of Dayton: "An increasing number and variety of requests for financial information indicated that the City of Fresno was outgrowing its existing system for providing information. Through a long and difficult process spanning more than two years the City has developed and 'translated' a new Financial Information System based on the City of Dayton model. The investment in the system has been high but with the continuing involvement and support of management it is anticipated that this tool will mature to the point that the monitoring, increased control, and flexibility it provides will be worth the effort," (p. 245). See Don Nolan, "The Fresno City Experience in Transfer or 'Translation' of a Financial Information System Using USAC Technology," *Computers, Local Government and Productivity*, Vol. II, Papers presented at the Thirteenth Annual Conference of URISA (Chicago: URISA, 1976), pp. 245-252. The complexity of this transfer effort was mainly due to its size, involving many batch programs and integrated data files, and covering the areas of payroll/personnel, accounting/disbursing, treasury management, purchasing, and a program/project activity recording structure for accounting and budgeting.

15. Danziger.
 16. These tendencies are documented in John P. Crecine, "A Computer Simulation Model of Municipal Budgeting," *Management Science*, No. 13 (July 1967), pp. 786-815, and *Governmental Problem Solving: A Computer Simulation of Municipal Budgeting* (Chicago: Rand McNally and Company, 1969).
 17. In the URBIS survey, we asked chief executives whether it was better to develop an application in-house, transfer it from another local government or transfer it from a private vendor. Over half (52%) of the chief executives favored transferring the applications from another government. Yet, only 22 per cent of the cities and counties have transfer experience. The chief executive's preference seems to make a difference in the transfer sites. The number of chief executives who preferred to transfer an application from another local government was higher in the transfer sites than in the URBIS population (66% versus 52%).
- The chief executive's preference also seems to be understood by the data processing managers in the transfer sites. The number of data processing managers who felt that the availability of low cost transferable applications was "important" or "very important" also was higher in the transfer sites than in the URBIS population (47% versus 37%). Additional information on the transfer issue and the preferences of chief executives is contained in William H. Dutton, "Major Policy Concerns Facing Local Executives," *Nation's Cities*, Vol. 13, No. 10 (1975), pp. 33-36.
18. Both of these programs are relatively small, independent of other programs, and operate in the batch mode. The Fire Station Locator, distributed by Public Technology, Inc., is a computer program for

comparing and evaluating alternative fire station site proposals using "response time" as the location criterion. UFIRS, *Uniform Fire Incident Reporting System*, is a computer program for generating management reports and analyses from fire incident records. It was developed jointly by the National Fire Protection Association and the Department of Housing and Urban Development (HUD) and is distributed by HUD.

19. George C. Hemmens, "Implementing the Integrated Municipal Information Systems Concept: The Charlotte, North Carolina Case," paper presented at the 57th Annual Conference of the American Institute of Planners, San Antonio, Texas, 1975, p. 19.
 20. The GBF/DIME system promoted by the U.S. Bureau of the Census illustrates the problem. The system, which is a method of coding data to geographic locations, was originally designed to assist the Bureau in its mail-out-mail-back procedure for census taking. The system requires verification and periodic updating locally because urban geography changes. The Bureau secures local assistance through "agreements" wherein the local governments receive matching financial support and technical assistance to implement and maintain GBF/DIME and access to various Bureau programs that will turn the system into a "tool for local decision making."
- The system serves local policy makers and managers directly mainly through its utility to various kinds of planners for community analysis, location studies, and service boundary studies. However, the system is inadequate to meet day-to-day operational needs for geographic data such as in police and fire dispatch; therefore, the local cost of maintaining the system is considered by some local governments to exceed the benefits for planning alone. The geoprocessing studies of the USAC cities discuss this issue and alternatives to GBF/DIME. See, for example: Public Safety Subsystem Project, *Geographic Indexing Support System Conceptualization and System Requirements* (Long Beach, Calif., 1973).
21. Hemmens, p. 14.
 22. Life cycle costing refers to the calculation of costs and benefits over the expected useful life of a system. Costs and benefits are calculated for three major phases: investment (comparable to design-development phase), implementation (comparable to transfer-adaptation phase), and operation and maintenance. For a system, or a computer application, to be cost-beneficial, there must be a net benefit when all three phases are considered together. Savings in one phase such as design-development may be outweighed by expenditures with no corresponding benefits for implementation, operation, and maintenance phases.
 23. The Census Bureau's GBF/DIME system is perhaps the best example. Local agencies that adopted the system in connection with the 1970 census are now being asked to assist with updating it for the 1980 census. See Note 20.
 24. Software catalogs might become an important aid to application transfer among local governments, but currently they aren't. Catalogues specifically dealing with local government computer applications are

nonexistent. The catalogues currently available rarely cover local government applications. For example, neither the Spring 1975 issue of *Skinny* (abbreviated version of *ICP Software Directory*) nor the 1974 NTIS *Directory of Computerized Data Files and Related Software* contains many "systems or utilities" software that is potentially useful to the operation of local government data processing installations; about half of the directory consists of such software. International Computer Programs, Inc., *Skinny* (Carmel, Ind.: International Computer Programs, Inc., 1975); and National Technical Information Services, *Directory of Computerized Data Files and Related Software Available from Federal Agencies* (Washington, D.C.: U.S. Department of Commerce, 1974).

25. The great variety in mainframes and operating systems is not only due to the variety of makes and models available at any time, but also due to the many changes that occur over time to the mainframe and operating systems. In addition, the applications themselves evolve through enhancements. Thus, for a particular computer application to be transferable, it must exist in multiple versions, and "version control" becomes a major problem in itself. One consultant's experience with these technical problems in relation to a financial management system is reported in James R. Paul and John L. McCarty's "FAMIS - A Study in System Transferability."
26. Equipment compatibility also may be a lesser problem today because a few computer vendors dominate the local government market. The URBIS survey shows that 60 per cent of the cities and 70 per cent of the counties over 10,000 population use at least one IBM computer mainframe. The number of IBM mainframe users increases with government size. For example, about 40 per cent of the cities between 10,000-25,000 use IBM mainframes and 75 per cent of those between 250,000-500,000 use IBM mainframes. After IBM, the smaller governments (between 10,000-25,000) use NCR and Burroughs computer mainframes about equally (25%). See Kenneth L. Kraemer, William H. Dutton, and Joseph R. Matthews, "Municipal Computers: Growth, Use and Management," *Urban Data Service*, Vol. 7, No. 11 (Washington, D.C.: International City Management Association, 1975); and Joseph R. Matthews, William H. Dutton, and Kenneth L. Kraemer, "County Computers: Growth, Use and Management," *Urban Data Service*, Vol. 8, No. 2 (1976).

The survey also shows that transfer is more likely to occur among local governments with the same information manufacturer. Fifty-nine per cent of the cities with the transfer experience had similar mainframe manufacturers and 71 per cent of the counties had similar vendors. Thus, the dominance of local government computing by a few vendors probably facilitates transfer among major groups of governments.

27. Fossum and Gottlieb question whether the result of design for transfer is worth the price either for the development city or another transfer city. See Bernard Fossum and Steven Gottlieb, "The Wichita

Falls USAC Project Viewed in Perspective," *Urban and Regional Information Systems: Information Research for an Urban Society*, Vol. I, Papers from the Tenth Annual Conference of URISA (Claremont, Calif.: URISA, 1973), pp. 280-285.

28. Data base management systems are a good example of an advanced technology that facilitates the designer's job but reduces the possibility of widespread transfer of applications developed on them. For example, Donald Luria, the former technical director of the Charlotte, North Carolina, USAC project, points out the following barriers to application transfer from these systems: "Computer programs that run under a particular data management system rarely, if ever, can be transferred to run under another data management system.
 . . . The structure of an integrated data base is a more subtle barrier to program transfer. In a job or application-oriented (non-integrated) system the files are structured to meet the processing requirements of a single or relatively small number of programs. In an integrated data base the files should be structured to optimize the service to a multitude of users. It follows then that computer programs that work efficiently against one file structure may be far from efficient against another file structure. Since the structure is a function of the nature and variety of applications and these will vary from city-to-city, another barrier to the transfer of programs is set in place" (p. 290). Donald D. Luria, "Success Depends on Transferability," *Urban Regional Information Systems: Information Research for an Urban Society*, Vol. I, Papers from the Tenth Annual Conference of URISA (Claremont, Calif.: URISA, 1973), pp. 286-293.
29. Even without frills, user-oriented design reduces the likelihood of transfer. For example, Luria (p. 286) says: ". . . there is an inverse relationship between the degree to which the system is operations based and integrated and the degree to which the systems programs are transferable. First, the more operationally based a system is, the more interactive it is. The more interactive it is, the more the programs become tailored to specific user-oriented procedures."
30. The characterization of the National Clearinghouse and Resource Center is simplified here for analytical purposes and is based upon participation in meetings and discussions with the USAC Support Panel, Assembly of Engineering, National Research Council, *Local Government Information Systems—A Study of USAC and Future Applications of Computer Technology* (Washington, D.C.: National Academy of Sciences, 1976).
31. Ninety-four per cent of the city and county chief executives responding to the URBIS survey felt "There should be some central place (independent of computer manufacturers) where local governments can go for technical advice and training in computing and data processing." (N=563)
32. This is one of the central conclusions of two observers from the Charlotte, North Carolina, IMIS project. See Hemmens and Luria, particularly the quotations in notes 28 and 29.